CHEMICAL HAZARD SUMMARY

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4, 4′-Methylenebis (2-Chloroaniline)

(MOCA)
(CAS 101-14-4)

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SCOPE OF THE DOCUMENT

This document focuses on the potential hazards of 4,4'-methylenebis (2-chloroaniline). The toxicity of the material is described. Methods for control of the hazards presented by this material are detailed. Information relevant to the workplace is emphasized.

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I. MAIN CONCERN

4,4'-Methylenebis (2-chloroaniline) (MOCA) has caused cancer in animals. There is concern that it may cause cancer in humans.

II. OCCUPATIONAL EXPOSURE

MOCA is a tan-coloured solid which comes mostly in the form of small pellets. Almost 99% of MOCA is used as a curing agent in the production of polyurethane plastics and coatings. MOCA is melted and mixed with a prepolymer to form the final product. MOCA has an extremely low vapour pressure, and under normal circumstances, presents no potential for vapour exposure either in the pellet or melted form. The principal risk of exposure comes from contact with very small particles of airborne MOCA through the skin, inhalation or ingestion[1,2]. This exposure occurs principally when MOCA is transferred from the container to the melter. Therefore, the main precautions to avoid contact should be implemented at this stage of the process.

General information on routes of exposure is available in the CCOHS document "How Workplace Chemicals Enter the Body"[3].

III. REMOVAL FROM THE BODY

The major route of excretion in humans is not very well documented. But MOCA was found in the urine of exposed workers[4]. No correlation between the amount of urinary MOCA and the airborne concentration has been established, but urine monitoring is used as a means of determining whether employees are being exposed to MOCA[1,5].

IV. FIRE, EXPLOSION AND REACTIVITY HAZARDS

There are no data on the fire, explosion and reactivity hazards for MOCA.

By analogy with a closely related chemical (4,4'-methylenedianiline), MOCA could be combustible. It can probably burn when exposed to a persistent source of heat such as an open flame. MOCA is probably not explosive. There are no data on reactivity.

V. EFFECTS OF SHORT-TERM OVEREXPOSURE IN HUMANS

Inhalation
MOCA reacts with the part of the blood which carries oxygen (hemoglobin). It forms a substance called methemoglobin. Unlike hemoglobin, methemoglobin does not have the ability to carry oxygen from the lungs to the tissues. If excessive concentrations of MOCA are inhaled, the tissues lack oxygen and a

condition called cyanosis develops. A sign of cyanosis is a bluish colour in the skin and the mucous membranes. Usually there is complete recovery when exposure is stopped[6].

Eyes
Hot MOCA accidentally splashed into the eyes has caused inflammation of the surface layer of the eyes (conjunctivitis)[7].

Skin
MOCA is mildly irritating to the skin[7]. Absorption through intact skin is the major route of entry in the workplace. Symptoms similar to those described for inhalation exposure may be expected.

Ingestion
Accidental swallowing (ingestion) of MOCA causes an upset stomach. Ingested MOCA is excreted very rapidly without evidence of further toxic effects[7].

VI. EFFECTS OF LONG-TERM OVEREXPOSURE IN HUMANS

Carcinogenic Effects
No conclusive data are available on the risk of developing cancer from occupational exposure to MOCA. However, the International Agency for Research on Cancer (IARC) states:

> "(...) for practical purposes, this chemical has to be regarded as presenting a carcinogenic risk for humans."

This decision is mainly based on the effects of similar chemicals on humans, and on the results of animal experiments[8]. Other organizations such as the U.S. National Institute for Occupational Safety and Health (NIOSH) and the American Conference of Governmental Industrial Hygienists (ACGIH) have also reached the conclusion that MOCA presents a cancer risk to humans.

Effect on the Bladder
Long-term exposure to MOCA can cause a mild temporary irritation of the bladder (cystitis) which can cause blood to appear in the urine[9].

VII. TOXICITY DATA IN ANIMALS AND LABORATORY TESTS

Lethal Dose Values
The poisoning strength of a compound can be estimated from the LD_{50} obtained in animal tests. LD stands for lethal dose. The LD_{50} is the amount of a chemical (weight of chemical per weight of animal) which is needed to kill one-half (50 percent) of the test animals. Test animals are usually rats, mice or other rodents. Routes of exposure are usually by mouth (oral), through the skin

(dermal) or by breathing in the airborne chemical (inhalation). The value reported for this material is:

LD_{50} (rat, oral) 2100 mg/kg

On a scale of 1 to 6, where 1 is practically non-toxic and 6 is super toxic[10], the poisoning potential of this chemical rates as 3 (moderately toxic).

Further general information on the LD_{50} is available in the CCOHS publication "What is an LD_{50}?"[11]

Other Animal Data

Mutagenic Effects
In laboratory tests MOCA has caused effects on the genetic material of bacteria and mammalian cells.

Carcinogenic Effects
Dogs fed large amounts of MOCA for up to nine years developed bladder cancer[12]. Rats and mice fed a diet containing high levels of MOCA over their lifespan (about two years) developed liver and lung cancers[13,14]. These quantities of MOCA and the route of exposure used in the experiments do not reflect workplace conditions but do indicate that MOCA has the potential to cause cancer.

VIII. EXPOSURE LIMITS

Many Canadian jurisdictions have exposure limits similar to those established by the American Conference of Governmental Industrial Hygienists (ACGIH). The exposure limit for 4,4'-methylenebis (2-chloroaniline) is*:

Time-weighted average: 0.02 parts per million (ppm) or 0.22 milligrams per cubic metre (mg/m^3).

*"Skin": Absorption by the unbroken skin, eyes or mucous membranes may contribute to the overall exposure.

The ACGIH has classified 4,4'-methylenebis (2-chloroaniline) as an industrial substance suspect of carcinogenic potential for man (ACGIH's notation: A2)[15].

Contact the appropriate authority in your jurisdiction for details of the specific regulations which apply. Refer to ACGIH documentation for information on the exposure limits.

IX. FIRST AID

Inhalation
Remove the source of contamination or move the victim to fresh air. If breathing has stopped, trained personnel should begin artificial respiration. If the heart has

stopped, begin cardiopulmonary resuscitation (CPR) immediately. The administration of oxygen is beneficial when it is used by a trained person, preferably on a physician's advice. Obtain medical attention immediately.

Eye Contact
Immediately flush the contaminated eye(s) with lukewarm, gently flowing water for at least 20 minutes holding the eyelid(s) open. Take care not to rinse the contaminated water into the non-affected eye. If the irritation persists, obtain medical attention immediately.

Skin Contact
Avoid direct contact with this chemical. Wear protective gloves if necessary. As quickly as possible, flush the contaminated area with lukewarm, gently running water for at least 20 minutes. Under running water, remove any contaminated clothing, shoes and leather goods. Obtain medical attention immediately. Discard contaminated clothing, shoes and leather goods. Do not re-use.

Ingestion
Never give anything by mouth if the victim is rapidly losing consciousness, or is unconscious or convulsing. Have the victim rinse the mouth thoroughly with water. Have the victim drink 240 to 300 mL (8 to 10 oz) of water. If vomiting occurs naturally, have the victim lean forward to reduce the risk of aspiration. Repeat administration of water. If breathing has stopped, trained personnel should begin artificial respiration or, if the heart has stopped, cardiopulmonary resuscitation (CPR) immediately. If possible, avoid mouth-to-mouth contact. Obtain medical attention immediately.

General Comments
Provide general supportive measures such as comfort, warmth and rest. Consult a physician and/or the nearest Poison Control Centre for all exposures, except minor instances of inhalation or skin contact. Some recommendations may be considered medical acts in some jurisdictions. These recommendations should be reviewed with a physician and appropriate delegation obtained, as required. All first aid procedures should be periodically reviewed by a physician familiar with the material and its conditions of use in the workplace.

X. EXPOSURE CONTROL

Engineering Controls
Engineering control methods to reduce hazardous exposures are preferred. These methods include mechanical (dilution and local exhaust) ventilation, process or personnel enclosure, control of process conditions and process modification. Administrative controls and personal protective equipment may also be required. Because of the high potential hazards associated with this substance, stringent control measures such as enclosure or isolation may be necessary. Supply sufficient replacement air to make up for air removed by exhaust systems.

In some work situations engineering controls and work practices may not be effective in controlling exposure to MOCA. In such cases, wear suitable personal protective equipment and approved respiratory protection.

Respiratory Protection
Have appropriate equipment available for use in emergencies such as spill or fire. If respiratory protection is required, institute a complete respiratory protection program including selection, fit testing, training, maintenance and inspection. Refer to the CSA Standard Z94.4-M1982, "Selection, Care, and Use of Respirators"[16]. No specific guidelines are available for respiratory protection in the case of 4,4'-methylenebis (2-chloroaniline).

Eye/Face Protection
Wear chemical safety goggles or a face shield.

Skin Protection
Wear gloves, coveralls, boots and/or other resistant protective clothing. Have a safety shower/eye-wash fountain readily available in the immediate work area.

XI. STORAGE AND HANDLING

Storage Conditions
Limit the quantity of material in storage. Restrict access to storage area. Post warning signs indicating that the material is suspected to be carcinogenic. Keep the storage area separate from populated work areas.

Store in cool, dry, well-ventilated areas, away from incompatible materials, heat and ignition sources. Store in suitable, labelled, dust-tight containers. Keep containers closed when not in use and when empty. Protect from damage.

Handling
Prevent the release of dusts or mists into workplace air. Follow routine safe handling procedures. Use the smallest possible amounts, in designated areas, with adequate ventilation.

XII. SPILL AND LEAK PROCEDURES

Precautions
Restrict access to the area until completion of the clean-up. Ensure that the clean-up is conducted by trained personnel only. Wear adequate personal protective equipment and ventilate the area. Notify government occupational and environmental authorities.

Clean-Up
Do not touch the spilled material. Prevent the material from entering sewers. Stop or reduce the leak if it is safe to do so. Contain the spill with earth, sand or an absorbent material which does not react with the spilled material. If the solid is spilled, shovel into clean, dry, labelled containers and cover. Flush the area with water.

In case of small spills, soak up the spill with absorbent material which does not react with the spilled chemical. Put the material in suitable, covered, labelled containers. Flush the area with water. In case of large spills, contact fire and emergency services and the supplier for advice.

Disposal
Review federal, provincial and local government requirements prior to disposal. Disposal by controlled incineration or secure landfill may be acceptable.

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Note: Additional references on this subject are available from CCOHS upon request.

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This summary was prepared at the Canadian Centre for Occupational Health and Safety (CCOHS) and is intended primarily as a source of information for persons who work with or may be occupationally exposed to this material. The information selected for inclusion is believed to be reliable and generally relevant to occupational health. Other information which bears on particular work situations may be available. The scientific data in many areas are limited and may allow a variety of interpretations. Additional information, corrections, comments and questions are welcome, and should be addressed to the Inquiries Service, CCOHS, 250 Main Street East, Hamilton, Ontario, L8N 1H6, (416) 572-2981; toll free 1-800-263-8276.

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